# HP Moonshot System

The world’s first software defined servers

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Introduction

HP Moonshot System is a revolutionary server design that addresses the speed, scale and specialization required for the new style of IT that is emerging around the converging trends of mobility, cloud, social media, and big data. With billions of people connected with each other and with businesses over the Internet, many of them from mobile devices, there is a rapidly escalating demand for digital content and experiences. The connection of almost any device to the Internet has become known as the Internet of Things (IoT). These devices can gather and process data, provide a service, and seamlessly interact with other devices. The IoT presents businesses with new ways to drive market differentiation, deepen customer relationships, and deliver profitability. These specialized IoT solutions require a new style of computing, one that can achieve optimal performance and efficient scaling.

From our position as the leading provider of x86 servers for internet environments we’ve created the HP Moonshot System, the second offering from HP Project Moonshot. HP Moonshot System is the world’s first software-defined server platform to deliver breakthrough efficiency and scale by aligning just the right amount of compute, memory and storage to get the work done, thereby enabling you to capitalize on the major growth trend of the IoT. The HP Moonshot System adopts a federated approach to server design that saves energy, cost, and enables extreme scale-out without a corresponding increase in complexity and management overhead. HP Moonshot 1500 Chassis incorporates common components that include management, fabric, storage, cooling, and power elements and accommodates up to 45 individually serviceable hot-plug Solution Cartridges. The innovative software-defined cartridges can include one or more servers and are designed for specific IoT solutions providing optimal results for a given workload. The workload range extends from dedicated hosting, data analytics, web front end to more advanced functions such as graphics processing units, digital signal processors, and field-programmable gate arrays. HP Moonshot enables enterprises to maximize their ability to innovate and speed their time to market with new services while reducing costs and energy use.

This technical whitepaper provides a high-level technical overview of the HP Moonshot platform, with the first Solution Cartridge, HP ProLiant Moonshot Cartridge based on Intel® Atom™ S1260 processor. In this paper, we explore the Moonshot physical architecture, key components, and management software.

For more information about the HP Moonshot System, visit hp.com/go/moonshot.

Challenges facing today’s data center

In this rapidly growing IoT environment, many things that we do every day, such as checking email accounts, posting onto social media sites, browsing web pages, and searching web indexes or portals—are not compute-intensive. They do however; have high I/O throughput and memory footprint requirements. IT architects working at this scale typically use cluster techniques to run massively parallel workloads that distribute data across many nodes, often in cloud environments. Using typical server x86 CPUs designed for compute-intensive enterprise applications in these environments means underutilizing compute capacity and wasting energy. Distributed workloads in cloud environments often run at low processor utilization levels of 20% or less, yet administrators pay for the cost of a premium CPU.

Virtualization can address the low CPU utilization problem if you can consolidate multiple workloads that are somewhat balanced, such as enterprise applications or infrastructure-as-a-service. Virtualization does not adequately address the needs of scale-out applications and web serving, where the I/O component is much larger and the amount of processing required per unit of data is much smaller. In these environments, consolidating through virtualization effectively reduces the network, memory, and I/O bandwidth per unit of data, which makes the large I/O problem worse. Project Moonshot takes the approach of using energy-efficient CPUs that balance performance and cost to match the needs of data-intensive applications.

Another issue that overwhelms IT managers in hyperscale environments is the sheer number of devices they must manage, power, and cool. With today’s rack-mount x86 platforms, you can have between 20 and 40 servers in a 42U rack. Scale-out optimized platforms like HP ProLiant SL can increase the density to 80 servers in each rack. Each server comes with its own management controller, network controllers, storage controllers, OS instance, device drivers, and so on. So every time you add a server, you must also procure multiple I/O devices and manage, secure, power, and cool them. While HP BladeSystem c-Class enclosures also provide a shared infrastructure, the HP Moonshot System takes the sharing to a new level by integrating the processor and chipset onto a single piece of silicon and sharing other resources across the system.

HP Moonshot System

HP Moonshot System is the world’s first software defined server accelerating innovation while delivering breakthrough efficiency and scale with a unique federated environment, and processor-neutral architecture. Traditional servers rely on dedicated components, including management, networking, storage, power cords and cooling fans in a single enclosure. In contrast, the HP Moonshot System shares these enclosure components. The HP Moonshot 1500 Chassis has a maximum
capacity of 1800 servers per 47U rack with quad server cartridges. This gives you more compute power in a smaller footprint, while significantly driving down complexity, energy use and costs.

The first server available on HP Moonshot System is HP ProLiant Moonshot Server based on Intel® Atom™ processor S1260, and it provides an ideal solution for web serving, offline analytics and hosting.

**HP Moonshot 1500 Chassis design**

The HP Moonshot 1500 Chassis incorporates independent component design and hosts 45 cartridges, two network switches, and the infrastructure components within the chassis. The Moonshot 1500 Chassis’ electrically passive design makes this completely hot pluggable design possible. The Moonshot 1500 Chassis uses no active electrical components, other than EEPROMs required for manufacturing and configuration control purposes.

Figure 1 shows the elements of the Moonshot 1500 Chassis. HP controls the design on all elements of the chassis except for the server (initial server contain a single server) and the network switch module which may be designed by the Moonshot server or network switch partners.

**Figure 1.**

The HP Moonshot 1500 Chassis accommodates up to 45 individually serviceable hot plug cartridges. Two high-density, low-power HP Moonshot 45G Switch Modules, each with a 10g x6 HP Moonshot 6SFP Uplink Module, handle network communication for all cartridges in the chassis. These switches use Layer 2/Layer 3 routing, QoS management (CLI, SFLOW), and require no license keys. The dual network switches and I/O modules provide traffic isolation, or stacking capability for resiliency. Rack level stacking simplifies the management domain.

The Moonshot System uses the HP Moonshot 1500 Chassis Management module (CM) module for complete chassis management, including power management with shared cooling. The server platform is powered by four 1200W Common Slot Power Supplies in an N+1 configuration and cooled by five hot pluggable fans also in an N+1 configuration. The CM uses component-based satellite controllers to communicate with and manage chassis elements. The modular faceplate design allows for future feature development.

Figure 2 shows the front/overhead view of the HP Moonshot System with a full complement of 45 cartridges and two network switches.
Figure 2.

HP Moonshot 1500 Chassis front view

Figure 3 is a rear view of the Moonshot 1500 Chassis showing five dual-rotor hot plug fans, four common slot power supplies. The Moonshot System also includes a connector for support of SL Advanced Power Management (SL-APM). SL-APM is a “top-of-rack” solution that can be cabled to the HP Moonshot System to provide an alternative rack-level management solution. The connection is located on the HP Moonshot 1500 Chassis Management module accessed on the rear of the Moonshot 1500 Chassis (Figure 3). In the initial HP Moonshot System release, SL APM provides functionality for remote on/off cartridge command. You handle SL-APM management through the SL-APM CLI. You can find more detailed information in the SL-APM User Guide at:


Figure 3.

HP Moonshot 1500 Chassis rear view

Front Panel LED functions

Front panel LEDs provide internal status indications for the Moonshot 1500 Chassis (Figure 4).
The Moonshot 1500 Chassis provides these front panel indicators:

- Power LED for overall chassis
- Chassis UID LED (and button)
- Chassis health LED
- Power / Health status LED for each cartridge and server
- Power / Health status LED for each Network switch

**HP ProLiant Moonshot Server**

Each software defined sever contains its own dedicated memory, storage, storage controller, and two NICs (1Gb). For monitoring and management, each server contains management logic in the form of a Satellite Controller with a dedicated internal network connection (100 Mb). Figure 5 shows HP ProLiant Moonshot Server with a single Intel® Atom™ processor S1260 and a single SFF drive.

**Figure 5.** HP ProLiant Moonshot Server and functional block diagram

These servers provide the base hardware functionality of the system. Future software defined servers can take the following forms:

- One or more discrete server with separate compute, storage, memory and I/O
- One or more complete cartridge designs with integrated compute, storage, memory, and I/O
- One or more forms of storage accessible to adjacent cartridges

Future servers will incorporate these descriptions to provide a wide degree of flexibility for customizing and tuning based on the desired performance, cost, density, and power constraints.

The available ProLiant Moonshot server design includes one processor and a single HDD or SDD. This server is ideal for application workloads such as website front ends and simple content delivery. Table 1 gives you the current server component descriptions.
The Intel Atom is the world’s first 6-watt server-class processor. In addition to lower power requirements, it includes data-center-class features such as 64-bit support, error correcting code (ECC) memory, increased performance, and broad software ecosystem. These features, coupled with the revolutionary HP Moonshot System design are ideal for workloads using many extreme low-energy servers densely packed into a small footprint can be much more efficient than fewer standalone servers.

Intel® Atom™ processor S1260 integrates two CPU cores, single-channel memory controller, and PCI Express 2.0 interface. Each CPU core will have its own dedicated 32KB instruction and 24 KB data L1 caches, and 512 KB L2 cache. The processors incorporate Hyper-Threading, which allows them to run up to 4 threads simultaneously. Additionally, the chips have VT-x virtualization enabled.

Each Moonshot server boots from a local hard drive, or the network using PXE. The Moonshot System use HP BIOS and “headless” operation (no video or USB). No additional HP software is required to run the cartridge. NIC, storage, and other drivers are included in the compatible Linux distributions (described later in the OS management section).
**HP Moonshot 45G Switch Module**

Two independent network switch modules reside inside the HP Moonshot 1500 Chassis. Throughout the lifecycle of the HP Moonshot System we will provide additional switch options as functionality of new cartridge designs require. This approach provides flexibility to the customer as well as HP as we create more fully featured switches.

Figure 6 shows the first switch offering for the Moonshot System, the HP Moonshot 45G Switch Module (45x1Gb downlinks). We’ve mated this switch to the corresponding uplink module in the back of the chassis. Later iterations of the network switches and uplink modules will align with the intended application tasks of future Moonshot platforms and cartridge options. These combinations of cartridges, switches, and uplinks allow us to provide customization necessary to meet customer’s application, budget, and I/O requirements.

![Ethemet Module Diagram](image)

The HP Moonshot 45G Switch Module includes these components:

- One Satellite Controller per switch
- One Broadcom Trident+ ASIC
- One P2020 Switch Management CPU
- One external management port per switch (a serial connector)
- Single Ethernet cable connection for simplified management (future firmware release)
- 45 1GbE downlink ports per switch
- Six 10GbE SFP+ uplink ports per switch

The management port on each switch module is connected to the 1Gb management network shared with iLO. You can use serial, SSH, or telnet sessions to access the switch CLI. The switch is compatible with SFLOW and standard SNMP MIBs to provide detailed switch statistics.

The switch feature set is standard layer 2 with limited layer 3 (Routing, QoS). Switch power requirements are 100W peak per switch, not including the power requirements for the I/O Module. The network switch allows you to externally stack Moonshot 1500 Chassis’ for improved resiliency and efficiency.
HP Moonshot 6SFP Uplink Module

The Moonshot 1500 Chassis includes two HP Moonshot 6SFP Uplink Modules in the rear of the chassis connected to the primary and secondary network switch. If you remove a network I/O Module, traffic normally handled by that network switch will not be available until you reinsert the module. There are six uplink SFP+ (10GbE or 1GbE transceivers) ports and one management serial port on the I/O Module faceplate.

HP Moonshot 1500 Chassis Management module

The CM handles health and management functions for the Moonshot System. The Moonshot iLO CM plays a very similar role to that of the Onboard Administrator in the HP ProLiant BladeSystem infrastructure. Four iLO processors (Figure 7) share the responsibilities of managing and reporting on all the various activities in the Moonshot 1500 Chassis. The workload is balanced across the four iLOs in order to support the 1500+ sensors, different cartridge zones, switches, serial interface, Ethernet interface, LED control, health policies for temperatures, fans, power supplies, and other internal responsibilities.

Figure 7.

You can read more about how the CM operates in the “Management” section of this document. The Moonshot CM is a hot pluggable module located in the rear of the Moonshot 1500 Chassis. The CM consists of two printed circuit assemblies (PCAs) within a hot pluggable module, the power and cooling controller and the CM controller. The power and cooling controller manages the power supplies, fan modules and the Ethernet switches management within the chassis. The CM controller communicates with all servers and switch modules within the Moonshot 1500 Chassis through an internal-only Ethernet network.

The CM has overall knowledge of the system configuration for all chassis components and determines compatibility among the installed cartridges and whether to allow each to be powered on. It manages the cartridge power sequencing to ensure each cartridge powers on in the right sequence. It also acts as the concentrator for serial ports from the chassis cartridges. External communications are available through an external 1Gbps Ethernet port on the rear of the Moonshot 1500 Chassis. An additional RJ45 connector on the CM allows all Moonshot 1500 Chassis’ within a rack to cascade as a single network.

Power and cooling

The CM power and cooling controller manages the N+1 fan and power supply configurations. Like all other Moonshot System components, the fans and power supplies are hot pluggable. The Moonshot 1500 Chassis includes five dual-rotor fan modules, and four common slot power supplies. Both are hot pluggable from the rear of the chassis. The current sharing feature of the power supply and the power distribution design allows power output between power supplies to vary no more than 10%.

HP Moonshot System availability technologies

HP Moonshot System availability technologies work to eliminate single points of failure and ensure reliability. Electrically passive Moonshot 1500 Chassis design, hot pluggable devices, multiple independent components, and closely linked firmware processes are the key availability technologies built into the system. All components comply with the HP build standards and testing requirements, and we’ve already documented that almost all removable devices within the HP Moonshot 1500 Chassis are hot pluggable.

Passive baseboard and midplane design

The Moonshot 1500 Chassis baseboard and midplane contain only electrically passive components to make failure highly unlikely. You plug servers and network switches into the baseboard. The midplane accommodates I/O modules, fans, the
CM module, and the thermal control module. The chassis also includes a separate power backplane for the power supplies. Separation of power and signals leads to better integrity of both.

**Independent components**

Servers, network switches, and I/O modules operate as independent devices. If you remove one device or if that device experiences a problem, the other devices in the Moonshot 1500 Chassis continue to operate without interruption. If one of the five dual rotor fans in the enclosure fails, all remaining fans spin up to maximum until you replace the affected fan. The four Common Slot power supplies operate in an N+1 configuration. The HP Moonshot System will continue to operate normally in the event of a fan or power supply failure.

**Hot pluggable devices**

The CM allows you to replace a server or any other hot pluggable component with the Moonshot 1500 Chassis powered on. The CM detects new hardware and allows it to power on consistent with the chassis power-on sequencing rules.

HP ProLiant Moonshot Server (cartridge) does not require the server to retain session information or status. Various configuration options for a cartridge are stored in the CM. Upon replacement of a cartridge, the previously applied configurations are applied to the new cartridge.

At the same time, the CM coordinates and executes firmware associated with replacement of a hot pluggable component. The CM retains all device status and firmware information.

When you replace a cartridge, the CM automatically stages and installs the appropriate firmware (When applicable) and all other configuration information, as shown in Figure 8.

**Figure 8.**

- **Cartridge removal**
  - CM notes removal of the cartridge
  - Generates event log entry and alert.

- **Cartridge replacement**
  - CM recognizes the new cartridge
  - If necessary, stages firmware updates
  - Generates event log entry and alert.

- **Server Boot**
  - CM boots boots server consistent with sequencing rules to initialize firmware

Hot pluggable component replacements occur while all other components in the Moonshot 1500 Chassis continue to operate without interruption. For more information about firmware maintenance, see the “HP Moonshot CM” management section later in this document.

**Chassis Manager removal and replacement**

If you choose to remove the CM module, management features provided by the module are suspended, but all cartridges and the network switches continue to function. You cannot add new hardware until the CM is restored. Fan modules will go into maximum cooling mode to ensure the Moonshot 1500 Chassis has enough cooling until the CM is available again.

CM removal requires re-application of the configuration. A CLI command in the CM allows you to easily collect the configuration and then re-apply it to the new CM. Later firmware releases will store the configuration in the chassis’ non-volatile memory. Simple commands will allow you to select the configuration and apply it to the replacement CM.
**Fabrics and topology**

We designed the HP Moonshot System to provide application-specific processing for targeted workloads. Creating a fabric infrastructure capable of accommodating a wide range of application-specific workloads requires highly flexible fabric connectivity. This flexibility allows the Moonshot System fabric architecture to adapt to changing requirements of hyperscale workload interconnectivity.

The Moonshot System design includes three physical production fabrics, the Radial Fabric, the Storage Fabric, and the 2D Torus Mesh Fabric. The fabrics are connected to 45 cartridges slots, two slots for the network switches, and two corresponding I/O modules.

Figure 9 shows the eight 10Gb lanes routed from each of the cartridge slots to the pair of core network fabric slots in the center of the Moonshot 1500 chassis. Four lanes from each cartridge go to one core network fabric slot and four to the other (A and B). From each core fabric slot there are 16 10Gb lanes routed to the back of the chassis to attach to an I/O module.

*Figure 9.*
**Radial Fabric**

The Radial Fabric provides a high-speed interface between each cartridge and the two core fabric slots.

The Radial fabric includes these links:

- 2x GbE channels
- One port to each network switch

Figure 10 illustrates a torus topology interlinking cartridge to cartridge in combination with the radial topology linking to the network switches.

*Figure 10.*

The Radial fabric handles all Ethernet-based traffic between the cartridge and external targets. The exception is iLO management network traffic using the dedicated iLO port.
Storage fabric

A Moonshot System Storage Fabric will use existing Moonshot 1500 Chassis connections to span each 3x3 cartridge slot subsection within the chassis baseboard (Figure 11). The Storage Fabric will be part of future HP Moonshot System releases. This fabric implementation will use the Storage Fabric as a connection between servers and local storage devices.

Figure 11.

In this implementation, SAS/SATA is sent over lanes between each adjacent cartridge for primary storage along with additional lanes to other cartridges in the subsection for redundancy or other storage requirements. Although the figure shows a specific configuration of compute and storage nodes, there is flexibility to configure the subsections in different ways as long it does not violate the rules of the interface or storage technology. While the example in Figure 11 shows the proximal fabric being used for SAS/SATA, any type of communication is possible due to the dynamic nature of the fabric.

2D Torus Mesh Fabric

Like the Storage Fabric, future releases of the HP Moonshot System will use existing Moonshot 1500 Chassis connections to implement the 2D Torus Mesh Fabric, providing a high speed general purpose interface among the cartridges for those applications that benefit from high bandwidth node-to-node communication. The 2D Torus Mesh fabric can be used as Ethernet, PCIe, or any other interface protocol. At chassis power on, the CM ensures the compatibility on all interfaces before allowing the cartridges to power on.

The 2D Torus-Mesh fabric is routed as torus ring configuration capable of providing four 10Gb bandwidths in each direction to its north, south, east and west neighbors. This allows the HP Moonshot System to meet many unique HPC applications where efficient localized traffic is needed.

- 16 lanes from each cartridge
- Four up, four down, four left, and four right
- Can support speeds up to 10Gb

Topologies

Topologies utilize the physical fabric infrastructure to achieve a desired configuration. In this case, Radial and 2D Torus Mesh fabrics are the desired Moonshot topologies. The Radial Fabric pathways are optimized for a network topology utilizing two Ethernet switches. The 2DTorus Mesh fabric pathways are passive copper connections negotiated with neighbors and optimized for topology protocols that change over time to accommodate future Moonshot System releases.
Moonshot System network configurations

Moonshot System network switches and uplink modules provide resiliency and efficiency when configured as stand-alone or stackable networks. This feature allows you to connect up to nine Moonshot 1500 Chassis and then to your core network, eliminating the need for a top of rack (TOR) switch.

- Dual switches provide traffic isolation or can be stacked
- Rack level stacking simplifies management domain
- Redundant switch configurations provide a more resilient infrastructure
- Layer 2, Layer 3 Routing & QoS, Management (CLI, SNMP, SFLOW). No license keys

Moonshot 1500 Chassis stacking

Stacking allows you to select a tradeoff between overall performance and cost of TOR switches. Stacking can eliminate the cost of TOR switches for workloads able to tolerate extra latency. The switch firmware architecture elects a master management processor to control all stacked switches. Stacking does not scale in a linear way; stacking size is constrained by the capability of a single management processor. The P2020 processor is sized to reliably stack nine network switches (405 ports).

We can create two stacked switches in a single rack with no performance issues. Up to nine modules can be stacked to form a single logical switch. A simple loop consumes two ports per I/O module in this Figure 12 layout.

Figure 12.
Management

The HP Moonshot System relies on a federated iLO system. Federation requires the physical or logical sharing of compute, storage or networking resources within the Moonshot 1500 Chassis. The chassis shares four individual iLO4 ASICs in the CM module with high-speed connections to the management network through a single management port uplink.

The CM provides a single point of management for up to 45 cartridges, and all other components in the Moonshot 1500 Chassis, using Ethernet connections to the internal private network. Each hot pluggable component includes a resident satellite controller. The CM and satellite controllers use data structures embedded in non-volatile memory for discovery, monitoring, and control of each component.

HP Moonshot 1500 Chassis Management module

The CM includes four iLO processors sharing the management responsibility for 45 cartridges, the power and cooling processor, two networks switches and Moonshot 1500 chassis management. We’ve federated the iLO system functionality by assigning certain iLO processors responsibility for managing certain hardware interfaces. We balanced the workload among the three cartridge zones in the chassis (physically separated by network switches), and dedicated one iLO processor to manage chassis hardware and the switches. Communication between the CM and the Satellite Controllers is an internal private Ethernet network. This eliminates the requirements for a large number of IP addresses being used on the production network.

The iLO subsystem includes an intelligent microprocessor, separate memory, and a dedicated network interface. iLO uses the management logic on each cartridge and module, and up to 1,500 sensors within the Moonshot 1500 Chassis, to monitor component thermal conditions. This design makes iLO independent of the host servers and their operating systems.

iLO monitors all key Moonshot components. The CM user interfaces and API’s include a Command-Line Interface (CLI) and Intelligent Platform Management Interface (IPMI) support. These provide the primary gateway for node management, aggregation and inventory. A text-based interface is available for power capping, firmware management and aggregation, asset management and deployment. Alerts are generated directly from iLO, regardless of the host operating system or even if no host operating system is installed. Using iLO, you can do the following:

- Securely and remotely control the power state of the Moonshot cartridges (text-based Remote Console)
- Obtain access to each and all serial ports using a secure Virtual Serial Port (VSP) session
- Obtain asset and hardware specific information (MAC Addresses, SN)
- Control cartridge boot configuration

Authentication

Local user accounts provide necessary security to the CM. Table 2 shows that the CM maintains existing iLO privileges, providing granularity and consistency between all existing HP SL iLO-based server platforms and the Moonshot System.

Table 2.

<table>
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<tr>
<th>Privilege</th>
<th>Compared to existing iLO-based platforms</th>
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<tr>
<td>Remote Console Privilege</td>
<td>Allows access to the Virtual Serial Port (VSP)</td>
</tr>
<tr>
<td>Boot Priority</td>
<td>Allow configuration of node level PXE/HDD boot settings</td>
</tr>
<tr>
<td>Power and Reset</td>
<td>Remains consistent with iLO</td>
</tr>
<tr>
<td>Configure CM</td>
<td>Same as configure iLO option</td>
</tr>
<tr>
<td>Administer User Accounts</td>
<td>Remains consistent with iLO</td>
</tr>
</tbody>
</table>

SMBIOS – Node Asset Detail / Inventory

The CM is responsible for transferring hardware information to the cartridge order that SMBIOS records can be populated with slot and Moonshot 1500 Chassis information. The HOST ROM normally provides this information on other servers (dmidecode).

iLO management interface

The CM CLI is the primary management interface. There is currently no web interface.
**Firmware maintenance**

The CM handles routine firmware maintenance throughout the Moonshot System. All deliveries of flashable firmware components to the CM use existing iLO features and are HPSUM-based. Firmware updates can include any hot pluggable HP Moonshot System component.

**Firmware update delivery**

HP SUM directs iLO to the appropriate flash package and configures iLO for firmware updates. Alternate delivery mechanisms (such as web, FTP, physical media) may be possible in future CM releases.

Using HP SUM to communicate with the iLO, you can flash these HP Moonshot System components:

- Cartridge Host ROM (Through the CM and Satellite Controller)
- CM firmware
- Satellite Controller

Components will be added with subsequent Moonshot releases

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**Note**

NIC and storage components are not included as part of a common update process.

---

**Flashing the the cartridge Host ROM**

Figure 13 shows firmware delivered to the CM, the CM communicating with the cartridge satellite controller, and SPI operations performed over private network to flash the ROM SPI flash component.

**Figure 13.**

---

**Flashing the the cartridge CPLD**

As in Figure 13, the firmware is delivered to the CM. The CM communicates with the cartridge satellite controller, and firmware is flashed over the private network. A reset is required in order for the firmware image to take effect.

The CM coordinates firmware interdependencies and updates all affected devices with procedures that minimize or eliminate workload interruption.

**OS deployment and support**

The Moonshot System hosts multiple individual systems, and network switches. Unlike other HP ProLiant BladeSystem-class servers, Moonshot cartridges provide OS installation only through network installation, with console access provided by an integrated Virtual Serial Port to each server. Network installation is performed in a manner similar to other HP ProLiant, or standard x86 servers, with the only required modifications being the specification of the serial console instead of a standard VGA display (described below.)
Linux Distributions
The initial release of the HP Moonshot System is compatible with these versions of Linux:

- Red Hat Enterprise Linux 6.4
- SuSE SLES 11SP2
- Ubuntu 12.04

Note
Check hp.com for the latest Linux release.

The initial HP Moonshot System release does not include Windows.

Serial Parameters
In your PXE server’s default configuration files, you’ll need to add the following parameters to make the menu visible in the cartridge’s serial console.

```
CONSOLE 0
SERIAL 0 9600
```

For each of your entries on your PXE server, you will also need to include an additional value to the “append” section of each to instruct the installation kernel to use the serial console. This should appear as:

```
console=ttyS0,9600n8
```

Lastly, after you’ve installed Linux on the server, either interactively or automatically (through a kickstart, preseed, or AutoYaST file), you must ensure that the same kernel option is appended at boot time.

Failure to include these serial console parameters will limit your ability to access the console of your servers via the CM. You may still be able to access your server via the network, but in the case of an emergency, you will not have direct access to the server.

HP Insight Cluster Management Utility
The HP Insight Cluster Management Utility (CMU) is well suited for performing network installations, image capture and deploy, and ongoing management of large numbers of servers such as the density provided by the Moonshot 1500 Chassis. If you are using CMU, the directions included in the following “Setting up an installation server” section are not required, and you should instead refer to the CMU documentation.

The CMU is optional and basic network installation of the OS may be performed using a standard PXE-based installation server.

Conclusion
The HP Moonshot System addresses the needs of data centers deploying servers at a massive scale for the new era of IoT. Industry sources estimate that lightweight web serving and analytics workloads will equal 14% of the x86 server market by 2015. The HP Moonshot System changes the current computing paradigm with an innovative completely hot pluggable architecture that increases the value of your investment and reduces TCO. You get a significant reduction in power usage, hardware costs, and use of space. You’ll see simplification in the areas of network switches, cabling, and management. Moonshot System’s use of shared hot pluggable infrastructure includes power supplies and fans. The HP Moonshot 1500 Chassis Management module, with proven HP iLO management processors, gives you detailed reporting on all platform components while the power and cooling controller manages the N+1 fan and power supply configurations. Dual network switches and I/O modules increase Moonshot’s resiliency and flexibility, allowing you to stack HP Moonshot Switch Modules. The Moonshot System is the first software defined, application-optimized server platform in the industry. Look for a growing library of software defined servers from multiple HP partners targeting specific IoT workloads compatible with emerging web, cloud, and massive scale environments, as well as analytics and telecommunications.
Resources

HP Project Moonshot home page
hp.com/go/moonshot

HP Project Moonshot business whitepaper
hp.com/V2/GetPDF.aspx/4AA3-9839ENW.pdf

HP Moonshot System A new style of IT accelerating innovation at scale
hp.com/bc/docs/support/SupprrtManual/c03724617/c03724617.pdf

HP labs paper, “Server designs for warehouse-computing environments”

HP industry-standard server white papers
hp.com/servers/technology

Learn more at
hp.com/go/moonshot